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# Two components of power spectral density for magnetosheath turbulence as identified from Cluster four-spacecraft measurements

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Cluster four-spacecraft measurements in the magnetosheath provide a good opportunity for revealing the nature of turbulent fluctuations close to the ion scale over there. As Cluster passed through the magnetosheath, it experienced a temporally and spatially varying local background magnetic field ($B_0$). For every sub-section of $B_0$, cross-correlations between fluctuations measured by six pairs of satellites are projected onto the 2D-coordinate space with abscissa parallel to $B_0$ and ordinate perpendicular to $B_0$. A 2D spatial correlation function (SCF) is thus established based on the projection results of cross-correlations. The SCFs of both the density fluctuations and the magnetic field fluctuations are estimated. We find that both of these two SCFs are similar in pattern to each other, appearing to be composed of two components, whereby the component parallel to $B_0$ dominates over the perpendicular one.

Corresponding 2D power spectral density is needed in order to know the distribution of fluctuation energy in the wave-vector (k) space. Instead of using the conventional 2D-FFT (Fast Fourier Transform) method, which fails to convert an observed 2D-SCF into a reliable 2D-PSD, we propose here a new method to reconstruct the 2D-PSD from the 2D-SCF based on the projection theorem about the Fourier transform (A.K. Jain, 1989). The resulting 2D-PSD is found to consist of two components as well, with the major component being oriented close to $k_\perp$ and the minor one close to $k_{ll}$. These new findings suggest that the turbulence energy in the magnetosheath may cascade mainly transverse to the mean magnetic field while a small fraction of it cascades along the field.